



Women's Livelihood Strategies and Sustainable Ecosystems in the Mahakam Estuary

Hastuti*

Department of Geography Education, Faculty of Social, Law, and Political Science, Universitas Negeri Yogyakarta, Indonesia

*Correspondence: hastuti@uny.ac.id

Arum Sekar Kedhaton

Department of Geography Education, Faculty of Teacher Training and Education, Universitas Mulawarman, Indonesia

Nurul Khotimah

Department of Geography Education, Faculty of Social, Law, and Political Science, Universitas Negeri Yogyakarta, Indonesia

Nur Ariyanto

Department of Geography Education, Faculty of Social, Law, and Political Science, University, Indonesia

Received: April 25, 2025 **Accepted:** June 20, 2026 **Published:** June 30, 2026

Abstract

This study aims to identify accessible livelihood resources for women, analyze the factors contributing to the marginalization of women in accessing livelihood resources, and develop a model for women's involvement in sustainable ecosystem management. The research was conducted in the Mahakam River Estuary, East Kalimantan. The study employed a mixed-methods approach, incorporating both quantitative and qualitative methods. The sample was obtained using purposive random sampling, with a total of 60 women household members. Informants included forestry extension officers from Delta Mahakam, female leaders of micro, small, and medium enterprises organizations, and women from forest farmer groups in the Mahakam Estuary region. The findings indicate that women in Muara Mahakam play a dual role as household managers while also contributing to the fisheries sector. However, unequal land distribution and patriarchal norms restrict their formal access to land, thereby limiting their autonomy in economic decision-making. Women in the Mahakam Estuary adopt livelihood strategies through yard and pond intensification and extensification techniques. Engagement in social networks, training, and capital assistance enhances the economic capacity of women in the Mahakam Estuary. Women's roles in sustainable ecosystem management in the Mahakam Estuary include utilizing abiotic and biotic components to support livelihoods and the economy. Women are also involved in coastal ecosystem conservation efforts by planting various types of mangroves.

Keywords: Woman Livelihood, Sustainable Environment, Mahakam Estuary

Introduction

Currently, women are increasingly engaged in public activities, such as economic ones, to generate income as their source of livelihood (Arthur-Holmes et al., 2023; Hendratni et al., 2022). However, the growing involvement of women in various fields does not automatically ensure equitable access to resources. Women still face economic, social, and other disparities in various sectors (Founou et al., 2023; Najam, 2024). These disparities in public sectors can be addressed by enhancing women's roles in various fields, including economics, social affairs, education, and the environment (Bataka, 2024; Li et al., 2024). Women's involvement in these fields is expected to contribute to household livelihood resilience, both socially and economically. Women engage in diverse activities across both domestic and public spheres, spanning household economies, education, and environmental roles, yet

they continue to face disparities in access to resources (Begum et al., 2022; Cook et al., 2023; Ekoula et al., 2023). Their livelihoods, encompassing social, economic, and household dimensions, are closely interwoven with the ecosystems in which they reside (Cameron et al., 2024). Consequently, when environmental degradation occurs, women constitute one of the most vulnerable groups, often bearing the heaviest burdens of ecological damage (Okere et al., 2024).

Women play a vital role in agriculture and rural economic development. Gender access to agricultural land and its impact on agricultural productivity, as well as gender-based sustainable livelihoods, are all integral to rural development policies. Understanding or gaining insights into gender access to agricultural land and its long-term sustainability will help address the needs of rural women in land acquisition. Women's access to land remains constrained by patriarchal structures, resulting in lower agricultural productivity among women-headed households. Evidence suggests that ensuring equitable access to land can enhance productivity and promote sustainable livelihoods (Azumah et al., 2023; Gebre et al., 2021). To address the challenges faced by women in gender access to agricultural land in rural areas, policies are needed to ensure gender equality in access to agricultural land.

Women strive to sustain their household economies through livelihood strategies by diversifying income sources to meet their families' primary and secondary needs (Pattimahu et al., 2023). Livelihood strategies reflect the efforts made by communities to achieve an adequate standard of living. These strategies are related to how communities manage or combine available livelihood assets, adapt to changes, and prioritize actions to maintain or improve their livelihoods. Livelihood strategies for households involve utilizing assets and capital options to invest in, sustain, and enhance resources and livelihoods (Hahury & Soselisa, 2021). The literature categorizes livelihood strategies into three types, survival, consolidation, and accumulation (Saleh, 2014). This framework provides a useful lens for explaining the variations in women's strategies in Muara Mahakam.

Women across the world continue to face various forms of inequality. Research indicates that women in northern Ghana are among the groups most vulnerable to climate change. While livelihood diversification can reduce climate vulnerability, it does not address gender-based differences in vulnerability. To enhance livelihood diversification amid climate change, climate efforts must focus on women, and fundamental gender-based discrimination, such as stereotypes and social biases, must be reduced or eliminated (Adzawla & Baumüller, 2021). Climate vulnerability is a global issue affecting the ability of populations to meet their needs, highlighting the importance of ensuring the sustainability of ecosystems where they live. Global agendas such as the SDGs emphasize the balance between meeting human needs and preserving the environment. This principle is particularly relevant for local communities, such as women in Muara Mahakam, whose well-being is highly dependent on the sustainability of coastal ecosystems. Goals that integrate a combination of socio-ecological policies promote both well-being and sustainability (Henderson & Loreau, 2023). Women remain a key group in sustainable development, as outlined in the SDGs. However, they face increasing life pressures and continue to encounter injustices, particularly from non-physical environments, such as societal structures, in accessing livelihoods.

A sustainable ecosystem is one that, through its normal cycles and disturbances, can maintain the diversity of major functional groups, productivity, and the rates of biogeochemical cycles. The interconnection of ecosystems within a landscape contributes to sustainability by creating or expanding feedback networks beyond individual patches. Sustainability in managed systems can be enhanced by maintaining interactive controls that produce negative feedback within ecosystems, as well as implementing laws and regulations to establish negative feedback between ecosystems and human activities, such as between marine ecosystems and fisheries. Degraded ecosystems can be restored through practices that amplify positive feedback, enabling the ecosystem to transition toward a state where interactive controls align with desired characteristics. The range of interactive controls governing ecosystem traits is limited by environmental factors, thus constraining the extent to which ecosystems can be sustainably managed for human purposes (Chapin et al., 1996).

Social, cultural, and religious rituals, along with natural resources, shape the unique ecosystem of the Mahakam River Estuary, guiding the community in maintaining sustainable interactions with their environment (Kedhaton & Hastuti, 2023). The beliefs upheld by the Mahakam River Estuary community reinforce their resilience and adherence to sustainable ecosystems as a source of livelihood, including for women within the society. Women represent a societal group highly committed to environmental preservation, striving to ensure that their surroundings remain a sustainable ecosystem that fosters positive energy in daily life for their families and communities. Women actively preserve the ecosystem by forming groups and social networks, collaborating through mutual assistance to manage the environment both during stable periods and under the pressures of household needs. They are acutely aware that environmental degradation disproportionately affects them, making them one of the most vulnerable groups. Women aim to shield their families from the adverse effects of environmental

damage. It is natural that women exhibit a strong inclination to maintain a conducive environment for the well-being of their families and surrounding communities.

Based on the background presented, the research problem focuses on women's livelihood strategies and sustainable ecosystems to preserve the environment, as well as the challenges women face in maintaining environmental sustainability and achieving adequate livelihoods. Drawing on this problem statement, the researcher is interested in conducting a study on women's livelihoods and sustainable ecosystems in the Mahakam River Estuary. This research aims to identify the resources accessible for women's livelihoods, analyze the marginalization of women in obtaining these resources, and explore models of women's involvement in managing sustainable ecosystems.

Methodology

The research was conducted in the Mahakam River Estuary, East Kalimantan. The Mahakam Estuary forms a delta consisting of islands created by sedimentation processes. This study employed a mixed-methods approach combining quantitative and qualitative techniques. The quantitative component was conducted through a structured survey involving 60 women from forest farmer households in the Mahakam Estuary. The survey collected data on women's socioeconomic conditions, livelihood assets, and their participation in fisheries-related economic activities. The qualitative component involved semi-structured interviews and field observations to explore women's access to livelihood resources, factors contributing to their marginalization, and their involvement in sustainable ecosystem management.

The qualitative informants were selected purposively based on their knowledge and involvement in local livelihood and ecosystem management programs. The informants consisted of forestry extension officers from the Mahakam Delta region, leaders of local Micro, Small, and Medium Enterprises organizations, and women leaders from forest farmer groups in the Mahakam Estuary. These informants were selected due to their active roles in community development, fisheries activities, and ecosystem conservation programs in the area. The survey respondents were selected using purposive sampling. A total of 60 women from forest farmer households in the Mahakam Estuary were chosen as respondents. These participants were selected because they are actively involved in fisheries-related livelihood activities such as aquaculture production, fish processing, and small-scale trading.

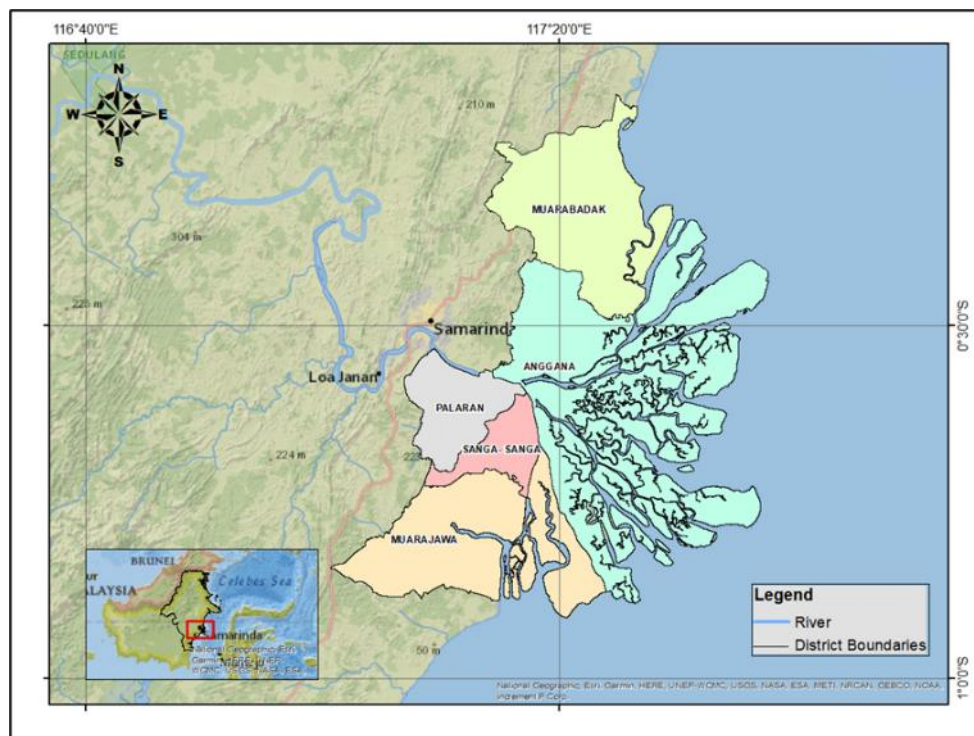


Figure 1. Administrative Map of The Mahakam Estuary

Data collection in this study employed surveys to ensure that the obtained data could generalize the population without significant discrepancies. Structured individual interviews were conducted to

gather primary data using pre-prepared instruments. Non-participant observation was used to directly observe and review the research objects. Questionnaires were designed by creating written questions directed at respondents. Documentation involved collecting data through documents relevant to the study.

To analyze women's livelihood strategies in Muara Mahakam, this study integrates two main theoretical foundations. The Sustainable Livelihoods Framework (SLF) serves as the basis for analyzing the five assets/capitals (natural, human, social, financial, and physical), as well as the vulnerability context, structures, and processes that shape livelihood strategies, which are measured and assessed as livelihood assets (Nasrnia & Ashktorab, 2021). This framework provides a lens for mapping how these assets are possessed and mobilized by households (Scoones, 1998). In addition, the Gender and Development (GAD) perspective emphasizes that gender-based power relations influence access to, control over, and benefits derived from resources. In practice, this implies that intra-group variations (e.g., age, education, and land ownership) determine women's capacity to participate in fisheries value chains and to access development interventions (Rice et al., 2024). The integration of SLF and GAD allows not only for a descriptive account of the assets held by women but also for an interpretation of how structural gender factors shape the distribution of assets and their adaptive strategies. These measurements are then stratified according to three demographic/structural variables age, education level, and land ownership status to uncover intra-group differences in asset ownership and livelihood strategies. Data were analyzed using descriptive cross-tabulation and qualitative triangulation.

Qualitative data collected through questionnaires were analyzed using descriptive quantitative methods, with frequency tables applied to variables such as the socio-economic conditions of women and women's livelihood strategies in Mahakam Estuary. For qualitative analysis, data validation was conducted using triangulation techniques, including sources, theories, and methods. Then, this data was analyzed to find results that could be used to figure out what resources are available for women, what makes women feel left out, and how women can help make Mahakam Estuary's ecosystems more sustainable. Qualitative analysis was also used to look at the underlying meanings of women's situations and ways of making a living, like how they meet their basic needs, own land, and have debts. This research was conducted from May to December 2024.

Results and Discussion

Results

The Mahakam Estuary is predominantly a delta region (Anwar & Subagiyo, 2021). The Mahakam Estuary falls under Kutai Kartanegara Regency (Anwar et al., 2021). The estuary spans five subdistricts: Muara Badak, Anggana, Muara Jawa, and the coastal areas of Sanga-sanga and several of Palaran area (Kedhaton & Hastuti, 2023). The local community largely utilizes the ecosystem for aquaculture and mangrove cultivation (Setiawan et al., 2015). Aquaculture and mangrove farming are prevalent in the coastal areas of Muara Badak, Muara Jawa Ilir, and Anggana, whereas mining, trade, and service activities dominate in Palaran and Sanga-sanga. Field observations reveal that the population in the Mahakam Estuary is mainly comprised of Bugis, Banjar, Kutai, and Javanese ethnic groups, with no single culture overwhelmingly dominating daily life.

The Mahakam Estuary offers abundant natural resources for the livelihood of its communities (Hutami et al., 2020; Syah et al., 2024; Wahyuni et al., 2020). The Mahakam River remains the primary water source for the local population, providing drinking water processed by the Regional Drinking Water Company (Agustianto et al., 2021). Apart from water, materials transported by the Mahakam River serve as essential building materials. The river is also rich in diverse freshwater fisheries, as the estuarine currents create an ideal environment for catching various fish species. Freshwater fish commodities are vital as a source of food and livelihood for the community. The Mahakam Estuary also contains significant oil and gas potential. Oil and natural gas extraction has been widespread along the coastal areas of East Kalimantan, with operations spread across much of the region's coasts and seas (Anwar & Subagiyo, 2021).

As the largest coastal ecosystem in East Kalimantan, the Mahakam Delta spans approximately 1,500 km², comprising mangrove areas distributed across 92 islands (delta) and the mainland mangrove regions of Kalimantan (Hutami et al., 2020). The Mahakam Delta is predominantly covered by forest vegetation, including freshwater forests and mangroves, which are spread throughout the delta area (Sodikin et al., 2021). The natural forest cover of the Mahakam Delta is primarily dominated by *Nypa fruticans* followed by other mangrove species such as *Avicennia spp* and *Rhizophora spp* (Sodikin et al., 2021; Wahyuni et al., 2020). Ecologically, mangrove ecosystems play a crucial role as breeding, spawning, and feeding grounds for various marine species (Jolpano et al., 2023).

The Mahakam Delta ecosystem boasts exceptionally high biological productivity and receives a supply of organic material as potential nutrients from upland areas via the 980 km-long Mahakam River. Consequently, this ecosystem holds significant fisheries resources, including fish, shrimp, and crabs. The primary livelihoods of the community in the Mahakam Delta are farming shrimp ponds and fishing. This indicates a relatively low reliance on forest resources. Shrimp ponds and fish constitute the main sources of income for the Mahakam Delta community (Hutami et al., 2020). Ponds are typically constructed extensively, as vast areas of mangrove forest are still available. Traditional extensive shrimp pond cultivation involves deliberately stocking juvenile tiger shrimp and milkfish alongside filling the ponds with river or seawater, allowing other marine species to enter and grow alongside the intentionally farmed species. This practice results in a mix of shrimp and fish species in the ponds, which are later harvested together (Wahyuni et al., 2020).

Table 1. Number of Fishing Households (Capture Fisheries and Aquaculture) in the Mahakam Estuary Region

Subdistrict	Aquaculture		Capture Fisheries		
	Pond	Tank	Fish Cage	Marine Fisheries	Inland Waters
Muara Jawa	1.418	75	-	1.342	75
Anggana	2.196	45	-	1.797	79
Muara Badak	1.475	270	-	1.689	-
Palaran	-	254	-	6.075	638
Sanga-sanga	725	-	21	726	134

Source: BPS-Statistic of Kalimantan Timur Province, 2024

There are ponds in the Mahakam Delta that aren't planted with anything and ponds that are planted with *Rhizophora* sp. This type of vegetation is a result of efforts to restore mangroves in the Mahakam Delta since 2002 (Rizal & Jailani, 2022). Women in Mahakam Estuary have open access to fisheries resources. Districts like Muara Jawa and Anggana have a high number of households involved in aquaculture, such as fish and shrimp farming, as shown in Table 3. The primary livelihoods of the coastal communities in Anggana District include fish and shrimp farming and fishing (Zuraida et al., 2020). Muara Jawa has 1,418 households engaged in pond farming, while Anggana accounts for 2,196 households.

Table 2. Capture and Aquaculture Fisheries Production in the Mahakam Estuary

Subdistrict	Pond (ton)	Tank (ton)	Fish Cage (ton)	Marine Fisheries (ton)	Inland Waters (ton)
Muara Jawa	19.062	44,05	152,47	11.950,2	47,1
Anggana	11.899,32	94,90	86	13.127	164,8
Muara Badak	19.349,77	138,50	-	12.502	-
Palaran	-	140	-	-	-
Sanga-sanga	-	39,60	29,10	1.495,4	29,6

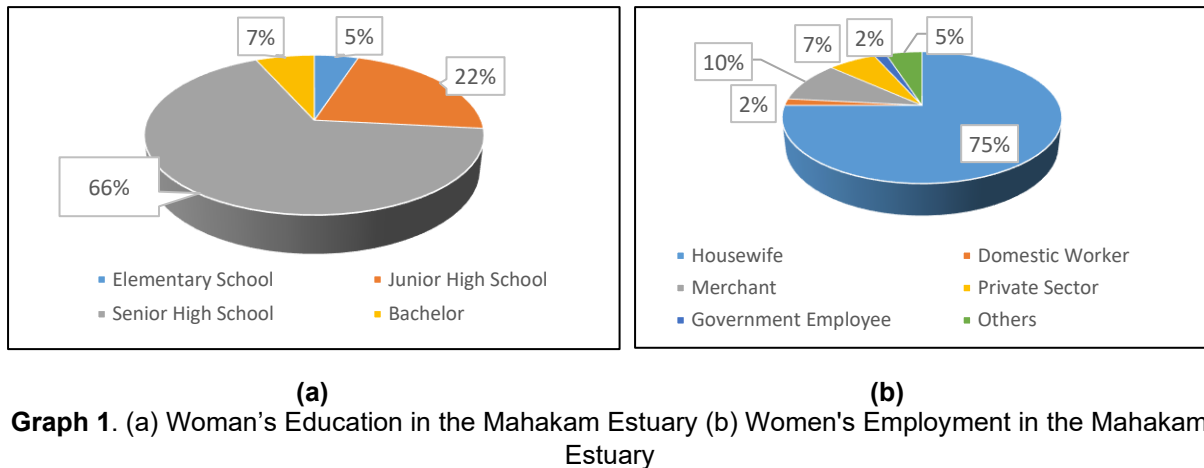
Source: BPS-Statistic of Kalimantan Timur Province, 2024

Aquaculture in Muara Badak Subdistrict produced 848.9 tons in 2020. According to the Muara Badak Subdistrict in Figures 2020 report, 925 households in Salo Palai Village, Muara Badak Subdistrict, engage in aquaculture, indicating that most residents are involved in the fisheries sector through aquaculture activities. The types of fisheries commodities developed by fish farmers include milkfish (*Chanos chanos F.*), giant tiger prawns (*Penaeus monodon*), and mangrove crabs (*Scylla serrata*) (Nawari & Purnamasari, 2023).

Socio-Economic Conditions of Women in Mahakam Estuary

Based on research findings, most women in the Mahakam Estuary area have not pursued higher education, with most being secondary school graduates. The ages of women involved in the study range from 18 to 65 years. As family members, women in Mahakam Estuary play dual roles as housewives and active contributors to the fisheries sector. Women frequently engage in aquaculture activities in the region. They assist their husbands in managing ponds, processing aquaculture products, and selling pond products, thereby demonstrating their significant involvement in the family economy. Despite having relatively low levels of education, women in Mahakam Estuary have adapted

well and play vital roles in the aquaculture sector, showcasing their resilience and contribution to household livelihoods.



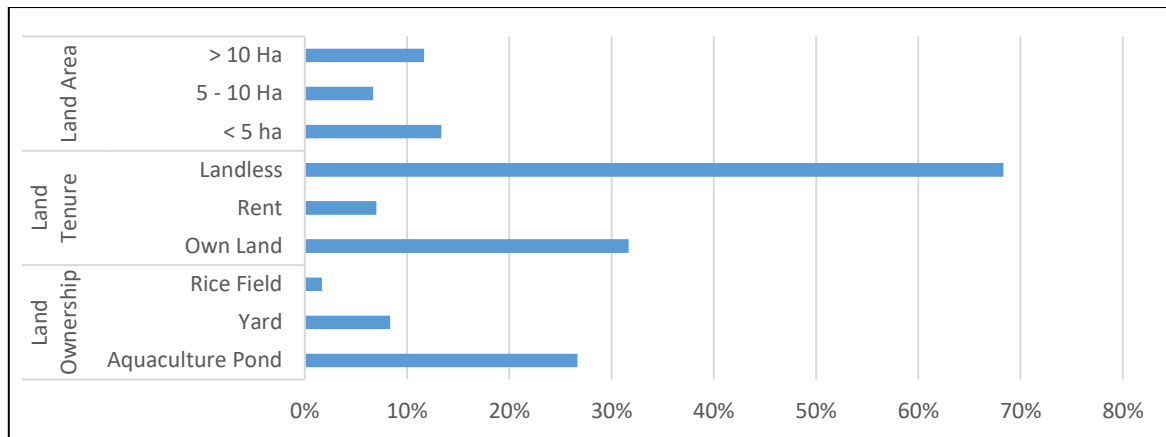
The high percentage of women who completed high school indicates an awareness of the importance of secondary education, even though access to higher education remains very limited. This reflects challenges in accessibility and economic factors that limit the ability to pursue further education. Dominance in the role of housewives indicates that most women in Mahakam Estuary focus on domestic responsibilities, which may limit their participation in formal economic activities.

The low percentage of women involved in the formal sector, such as private companies and civil service positions, shows limited access to more stable jobs with fixed salaries. Most women in the coastal areas of Mahakam Estuary own shrimp farmland, which serves as their primary livelihood source. These shrimp farms are generally used for cultivating fish, shrimp, crabs, and shellfish, which are key commodities in the Mahakam Estuary region (Syah et al., 2024). This aligns with the livelihoods of the community in the Muara region, particularly in the Delta Mahakam, where shrimp farming and fishing are dominant (Wahyuni et al., 2020).



Figure 2. Fish and Shrimp Farming in the Mahakam Estuary using *Silvofishery*

The ownership of fish farms strengthens the social position of women in the community. Women are not only responsible for managing households but also contribute to the local economy. This demonstrates that women in Mahakam Estuary play a dual role, both in the domestic and public sector (Norhadi, 2019). Women in Mahakam Estuary manage fish farms through land ownership, typically between 1 to 5 hectares, which allows them to run independent fish farming businesses and earn a stable income. For women who do not own land, they can still participate through a leasing system. This system enables women to work and earn income, albeit with lower initial capital.



Graph 2. Land Ownership Conditions of Women in the Mahakam Estuary

Based on the data presented in the table, women in the Mahakam Estuary have limited access to agricultural land, with aquaculture pond dominating land ownership. The limited land area suggests challenges in terms of economic scale and productivity, which likely affect their income and economic well-being. This underscores the importance of support, such as training, access to capital, and technology, to maximize the economic potential of the land they own.

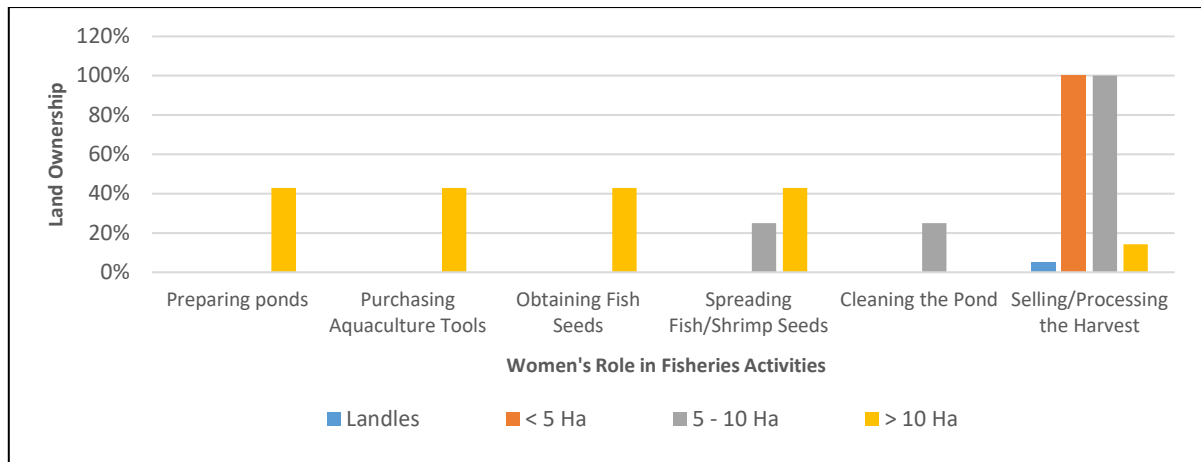
The socio-economic condition of women in the Mahakam Estuary is also influenced by how land is controlled. With most land being privately owned, women enjoy stability and security in managing their businesses. However, a significant gap in land ownership status is evident in this region, with some individuals possessing more than 100 hectares of land. In contrast, the majority of women own no land, making rental arrangements the primary means of accessing productive land, which continues to reflect their dependence on others.

This reflects the complex economic dynamics where women must manage limited resources while seeking ways to enhance their income and well-being through the optimization of available land. Nevertheless, income is also affected by factors such as weather, market prices, and the condition of the farms themselves. Unpredictable seasons can impact earnings, but stable income shows that fisheries sector remains a promising business option for women in Mahakam Estuary.

Most of the land ownership by women in Mahakam Estuary is under the name of the head of the household, typically their husband, even though women contribute significantly to the fisheries sector. Women's limited access to land in Muara Mahakam is not merely an individual issue but is rooted in structural mechanisms that position them in subordinate roles. Inheritance systems, still dominated by patriarchal norms in which land is more frequently transferred to sons, have left many women landless despite their active engagement in productive activities. Gender bias in agrarian regulations and village-level policies further reinforces this condition, as land ownership documents are typically registered under men as household heads. This situation effectively excludes women from opportunities to access formal credit or government assistance programs that require proof of asset ownership (Girma, 2021; Montcho et al., 2023).

Economic Livelihoods of Women in Mahakam Estuary

Women in the Mahakam Estuary region play a crucial role in the fishing sector, particularly in fish and shrimp farming. They are involved in various stages of farm management, from feeding fish to processing the fishery products. In addition, women also contribute to the sale of derivative products from wild-caught fish, such as salted fish, fish crackers, and shrimp paste. This involvement not only enhances the productivity of the shrimp farms but also creates job opportunities, increases household income, and demonstrates the strategic role of women in supporting the sustainability of the fisheries sector in Mahakam Estuary.

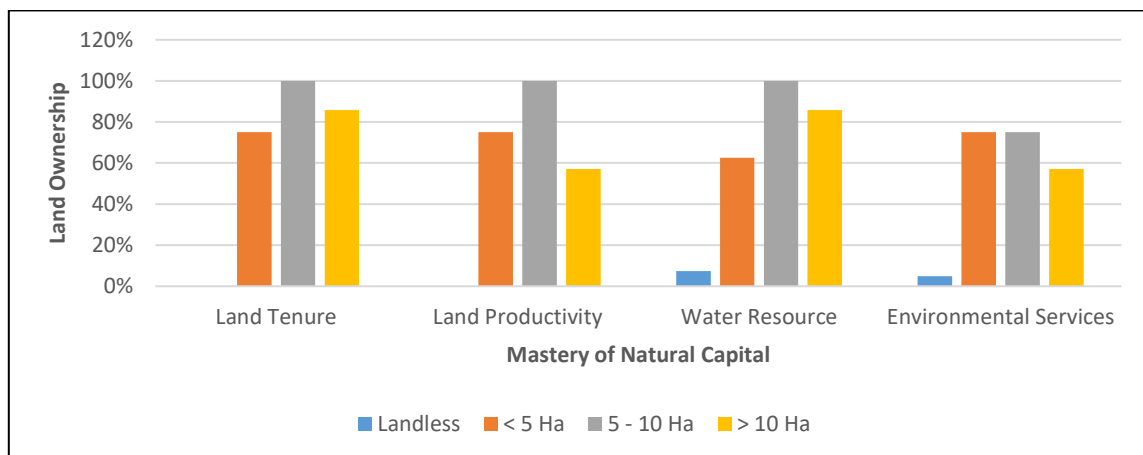


Graph 3. Women's Role in Fisheries Activities by Land Ownership in the Mahakam Estuary

The table illustrates that women's economic activities in fisheries management in Muara Mahakam vary considerably according to the size of land ownership. The first steps in the fisheries production cycle are not the main things that women in this area do every day. Women are involved in the maintenance phase of fisheries production (stock fish or shrimp seeds, buy, and provide feed), which is very important for determining the quality and quantity of the harvest. The most prominent economic activities among landless women include their contributions to selling or processing harvested products. These activities directly influence household income. The role of women within households is considered highly strategic in increasing household income, making it a critical indicator of family welfare improvement (Permaisari et al., 2022).

1. *Mastery of Natural Capital*

The mastery of natural capital among women in the Mahakam Estuary encompasses several critical aspects forming the foundation of their economic activities. One of the primary aspects is land ownership, particularly fishponds, which serve as the main source of livelihood. Some women adopt the *silvofishery* model, where the edges of their fishponds are planted with mangroves, enhancing pond productivity while supporting mangrove ecosystem conservation (Hardi et al., 2023). However, due to limited labor and financial resources, others are unable to implement such changes in their management practices effectively. As a result, they tend to rely on high shrimp and fish prices rather than improving production yields (BBPSILH, 2017).



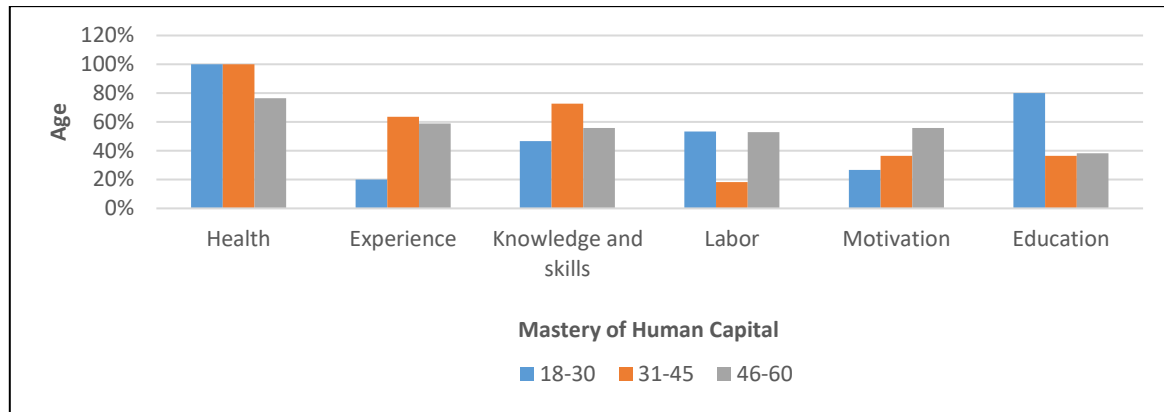
Graph 4. Women's Natural Capital Control by Land Ownership in the Mahakam Estuary

The data indicate that the larger the area of land controlled, the greater the capacity of women to manage the productivity of their fishponds. Land ownership constitutes a key factor in securing natural capital. Women without land face significant limitations, particularly in terms of land tenure and land productivity, as their access to resources is restricted to rental arrangements or employment in fishponds owned by others. Nonetheless, this group maintains a limited degree of involvement in water resources and environmental services. Women in the Mahakam Estuary make use of the ecosystem services provided by the surrounding natural environment. Rivers serve as critical transportation routes

for distributing products to nearby markets, while the estuaries supply various natural resources such as fish, shrimp, and crab seeds and provide a habitat for mangroves that support the overall pond ecosystem.

2. *Mastery of Human Capital*

The mastery of human capital among women in Mahakam Estuary encompasses aspects such as health, experience, knowledge, and skills in product processing, packaging, and marketing acquired through innovation. Women's ability to manage various aspects of production and marketing of fishery products demonstrates high adaptability and optimal utilization of available resources.



Graph 5. Women's Human Capital Control by Age in the Mahakam Estuary

Women in early adulthood demonstrate better levels of health and education compared to older age groups. The productive phase of women aged 31–45 years is characterized by stronger health, experience, knowledge, and skills. In contrast, older women face challenges related to declining health and physical strength, which in turn affects their capacity to participate in economic activities.

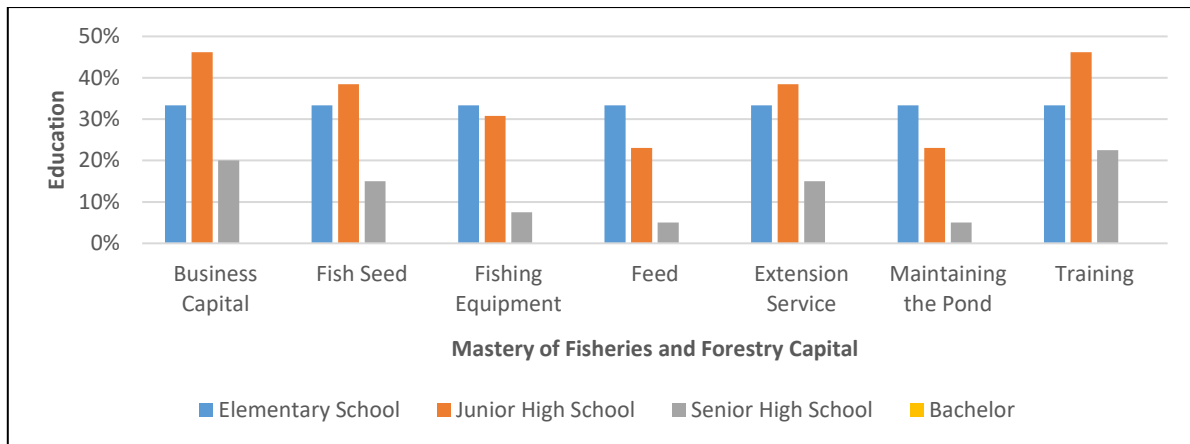


Picture 3. (a) Mangrove Ecosystem Rehabilitation Training (b) Processed Fishery Products by Women in the Mahakam Estuary

Women in Mahakam Estuary frequently participate in training sessions organized by various governmental agencies such as the Delta Mahakam Marine and Fisheries Office, the Delta Mahakam Forest Management Unit, and Indonesia's Peatland and Mangrove Restoration Agency. These training programs cover topics directly relevant to their economic activities, including aquaculture techniques, processing of fishery products, planting and maintenance of forest yields, and strategies for product marketing. Through these sessions, women gain new knowledge and skills that enhance the productivity and efficiency of their businesses. This support bolsters women's capacity to innovate and contribute significantly to the local economy, despite their generally limited formal education background (Amalia et al., 2023).

3. *Mastery of Fisheries and Forestry Capital*

Women in the Mahakam region play significant roles in fisheries capital, engaging in various aspects of production, such as feeding, processing, and selling fishery products from aquaculture and capture fisheries. Moreover, they actively participate in extension services and training related to fish farming, fishery product processing, packaging, and marketing.



Graph 6. Women's Fishery Capital Control by Education in the Mahakam Estuary

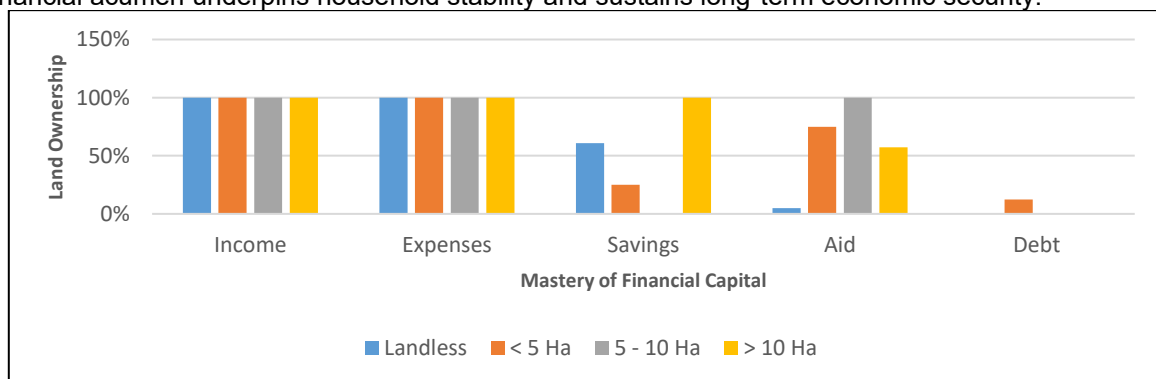
Women with elementary and junior secondary educational backgrounds constitute the largest proportion across nearly all aspects, including access to business capital, fish seed, aquaculture equipment, feed, and pond maintenance activities. This reflects the predominance of women with lower educational attainment who are actively engaged in the fisheries sector. This pattern arises from the tendency of women with higher education levels to seek employment in the private and formal sectors, which are less dependent on natural conditions and provide more stable income. The limited involvement of highly educated women in the fisheries sector presents a particular challenge for fostering innovation, promoting technology adoption, and developing strategies to reduce dependence on natural resources.

Fish resources in the Mahakam region are predominantly sourced naturally from the sea before being transferred to aquaculture ponds for farming. The financial and material support provided to women in the Mahakam Estuary, whether by government or private institutions, plays a significant role in enhancing their fisheries management capacity. This assistance includes the provision of fish seedlings, tools for processing fishery byproducts, and funding for fisheries management activities.

Some women in the Mahakam Estuary have access to forestry capital. This is evident in the practice of *silvofishery*, which integrates aquaculture with mangrove planting, offering both ecological and economic benefits (Setiawan et al., 2015). Women play crucial roles in this system, particularly in crafting protective stakes for mangrove seedlings before transplantation. Women also actively engage in processing and marketing mangrove-derived products. These include syrups, decorative items, and various mangrove-based food products with high economic value.

4. Mastery of Financial Capital

Women in the Mahakam Estuary actively participate in diverse economic sectors such as fisheries, agriculture, and micro-enterprises. Their income stems not only from production and sales activities but also from independently managed side businesses. Moreover, they are deeply involved in household expenditure management, including budget planning and cost control for daily living expenses. This financial acumen underpins household stability and sustains long-term economic security.



Graph 7. Women's Financial Capital Control by Land Ownership in the Mahakam Estuary

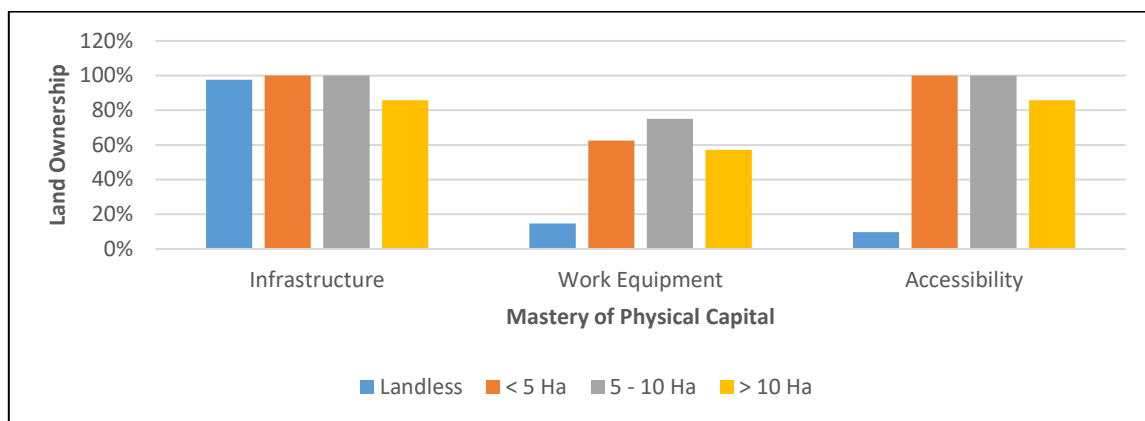
In terms of financial capital, women with larger landholdings demonstrate greater capacity to set aside savings compared to those with smaller plots. This pattern can be explained by the higher operational costs required to manage medium-scale aquaculture systems, including greater

expenditures on feed, seed, equipment, and labor. By contrast, landless women tend to face significant limitations in accumulating financial assets.

Financial assistance received by Mahakam women from various institutions, both governmental and private, plays a crucial role in strengthening their financial capital. This support may take the form of startup funds for creating businesses or equipment for fisheries and product processing. These assistance programs aim to enhance women's economic capacities and reduce dependency on a single income source.

5. *Mastery of Physical Capital*

Women's physical capital in the Muara Mahakam region encompasses infrastructure, work equipment, and accessibility that support their economic and social activities. Infrastructure such as fisheries and agricultural processing equipment is essential for improving work efficiency and productivity. Adequate tools allow women to process and market products with higher quality, enabling them to compete in both local and regional markets. Additionally, the availability of supporting facilities such as storage warehouses and training centers contributes significantly to improving women's skills and knowledge in managing their businesses. These resources help create sustainable economic opportunities while fostering self-reliance and long-term development for women in the region.

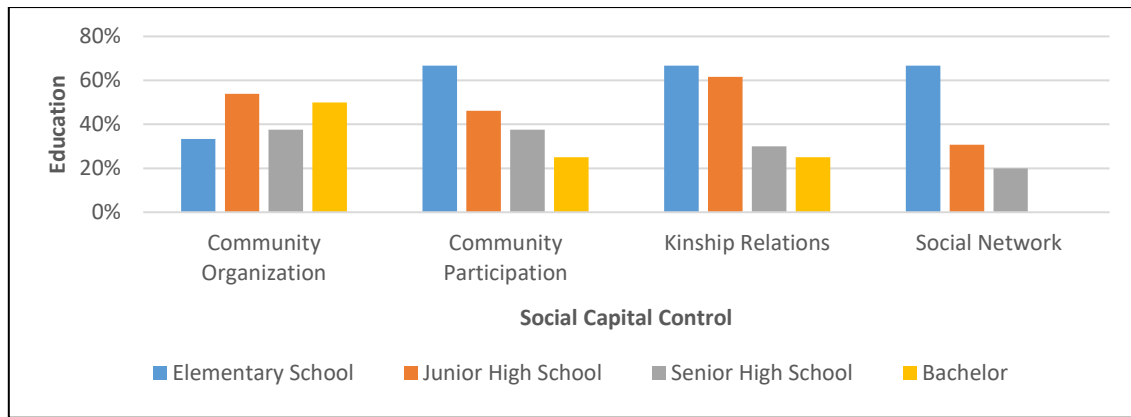


Graph 8. Women's Physical Capital Control by Land Ownership in the Mahakam Estuary

These findings confirm that land ownership has a strong influence on the level of physical capital possession. The larger the landholding, the greater the capacity of women to utilize infrastructure, work equipment, and transportation facilities. Conversely, landless groups face limitations in production tools and accessibility. Restricted access to transportation has the potential to reduce their competitiveness in distributing fishery products to markets. Transport tools such as speedboats and motorized boats are the main means of mobility in the Mahakam River delta region, which is characterized by vast water areas and large river channels. Speedboats and motorized boats not only facilitate the transportation of fisheries and agricultural products, but they also provide faster and more efficient access to markets and other economic activity centers.

6. *Social Capital Control*

The ownership of social capital by women in the Mahakam region is reflected through their active involvement in various organizations, such as Forest Farmers Groups and Micro, Small, and Medium Enterprises organizations. The findings on women's social capital in Muara Mahakam reveal varying patterns when examined across different educational levels.



Graph 9. Women's Social Capital Control by Education in the Mahakam Estuary

Women with basic education dominate nearly all aspects of social capital. Those with lower educational attainment tend to be more embedded in local social structures and more actively engaged in community solidarity. This occurs because they have greater economic dependence on social networks, whether for accessing capital, information, or support in fisheries enterprise management. Social capital thus functions as a compensation for the limited human capital (formal education) possessed by this group. The lower the level of formal educational assets held by women, the higher their tendency to mobilize social networks as a survival strategy. This is consistent with previous studies, which argue that close relationships and extensive social networks serve as social capital that enables women to manage businesses more effectively and contribute to broader community development (Baiduri & Harahap, 2024). From a GAD perspective, this pattern indicates that patriarchal structures limiting formal access compel women to rely on social networks as a survival strategy (Cookson et al., 2023).

Woman's Livelihood Strategies and Involvement in Sustainable Ecosystems

The livelihood strategies of women in Mahakam Estuary include intensification and extensification approaches to optimize the use of available land. Some women utilize yard spaces to grow vegetables. The extensification strategy is applied using shrimp pond land for mangrove planting in a *silvofishery* for improving shrimp pond productivity and environmental sustainability. Economic activities are diversified through involvement in fisheries, small-scale trade, and transportation services. Many women operate microenterprises selling staple goods and processed foods, leveraging local social networks and boat transport to access broader markets. Women in the Mahakam Estuary do not migrate elsewhere for livelihood opportunities. Instead, they prefer to focus on fisheries and maximize the use of local resources in Mahakam Estuary as their primary livelihood.

Survival strategies emphasize prudent financial management, including income diversification and efficient household budgeting. Women actively participate in both productive and reproductive spheres, maintaining household stability while engaging in economic and natural resource management. Access to institutional support, such as capital, equipment, and technical training from government and private sectors, plays a crucial role in enhancing women's entrepreneurial capacity, particularly in the development of value-added fishery products through micro, small, and medium enterprises. Consistent with Simarmata et al., (2023), the diversification strategies of women in Mahakam demonstrate that livelihood sustainability is determined not only by access to natural capital but also by institutional support that facilitates the development of microenterprises and strengthens women's collective roles.

The accumulation strategy employed by women in Mahakam Estuary focuses on increasing income through the development of processed fisheries products from ponds and wild catch through micro, small, and medium enterprises. These businesses aim to make more effective and sustainable use of local fishery resources. Distributing processed products to various regions not only boosts women's income but also broadens the market for local products. Investments and business expansion by women in the Mahakam Estuary focus on adding innovative derivative products from fishery ponds and wild catch that have high market value. They take strategic steps in developing product variations, such as processing fishery products into value-added goods like processed foods, decorations, or even eco-friendly products. Women in Mahakam Estuary are also engaged in converting estuary land into shrimp ponds. This land conversion leads to the destruction of natural mangrove ecosystems that should protect coastal areas from erosion and saltwater intrusion if carried out without a sustainable environmental approach.

Women in the Mahakam Estuary use the land, water, climate, and topography as part of their daily lives and as main resources for shrimp farming and wild catch fisheries. They make the best use of

shrimp pond land for fish farming and other fishery products, and they also use the climate and topography to keep their environment productive. Sunlight is creatively utilized for various purposes, including drying fish catches to produce products like salted fish and fish crackers. The use of solar energy as an alternative to electricity is also an important solution in the region, particularly in areas not connected to the formal power grid. Women in Mahakam Estuary integrate simple technologies into their daily activities, demonstrating adaptability to an unstable environment. Efforts to maintain local wisdom and integrate innovation into daily practices not only preserve natural resources but also enhance the quality of life and the economic resilience of women's communities in Mahakam Estuary.

Women in Mahakam Estuary rely on various biotic components for their livelihoods. The marine fauna utilized includes a variety of fish species such as milkfish, snapper, kipper, tilapia, tiger prawns, white shrimp, spotted shrimp, and mangrove crabs. The estuarine flora also plays a vital role for women in the Mahakam Estuary. Women in the Mahakam Estuary utilize mangroves, such as *Rhizophora*, *Avicennia*, *Bruguiera*, *Ceriops*, and *Nypa* as raw materials for various derivative products, such as syrup, decorative items, and natural fabric dyes. The sustainable use of these biotic components reflects local wisdom in responsibly utilizing natural resources. Women in Mahakam Estuary not only maintain the local ecological balance but also contribute to the economic and social sustainability of their communities. The development of sustainable fisheries and other economic activities ensures the availability of resources for future generations while preserving the rich and diverse environmental heritage of the region. This can be understood as a form of asset-based adaptation, in which the utilization and preservation of natural capital are carried out simultaneously to ensure livelihood sustainability (Scoones, 1998).

The use of social facilities for the livelihoods of women in the Mahakam Estuary includes access to education and health services. Schools and health centers are essential for supporting the development and well-being of women in this community. The utilization of economic and cultural facilities such as markets, money transfer services, and art training has become the center of main trade activities and the development of local traditions.

These strategies represent the livelihood outcomes resulting from the interaction of the five livelihood capitals available to women in Muara Mahakam in SLF framework (Scoones, 1998). The processes of intensification, diversification, and accumulation illustrate how constraints in one form of capital (e.g., limited land ownership) can be compensated through the optimization of social capital or innovations derived from human capital. Women's livelihood strategies are not static but adaptive to vulnerability contexts such as fluctuations in fish prices, mangrove degradation, and limited market access.

These strategies also reflect distinctive gendered roles from GAD perspective, with women being more dominant in downstream activities (processing, marketing, and product diversification) than in upstream roles (pond ownership). Although women are rarely registered as formal landowners, they play a strategic role in sustaining household economic resilience and maintaining ecosystem balance through community-based conservation practices. Women's livelihood strategies in Muara Mahakam thus function not only as survival mechanisms but also as tangible contributions to coastal ecosystem sustainability and community development (Rice et al., 2024).

Discussion

Resources Accessible for Women's Livelihoods

This study reveals that women in the Muara Mahakam Estuary play a crucial role in natural resource management, particularly in the aquaculture and forest conservation sectors. Consistent with research conducted on Fijian women (Thomas et al., 2021), women engage in fishing across a broader range of habitats (from inland rivers to open seas) and catch more species than previously described. Many women also operate boats and fish alongside men (Macusi et al., 2023). The participation of Muara Mahakam women in mangrove ecosystem protection and rehabilitation efforts also enhances the sustainability of coastal ecosystem resources. Women's involvement in forest management institutions, including village conservation forums, community forums, community patrol groups, and joint management committees, has increased their awareness and understanding of government regulations on forest conservation, expanded their social networks, and created opportunities for involvement in alternative income-generating activities (Begum et al., 2022; Rashid & Sultana, 2025).

Women in the Mahakam Estuary rely on various livelihood assets, including land ownership, fisheries resources, social networks, and financial support. Access to pond land plays a particularly important role in shaping women's economic activities in fisheries production. These findings indicate that the greater the livelihood assets (particularly land ownership), the broader the range of activities that can be undertaken, spanning from initial production stages to marketing. Conversely, landless women tend to concentrate on downstream activities, such as sales and processing, as survival

strategies. This evidence aligns with the Sustainable Livelihoods Framework (SLF), which emphasizes that household survival strategies are strongly shaped by the assets they possess, including human capital, natural resources, physical assets, financial capital, and social capital. A household's survival strategies are greatly influenced by the livelihood assets they possess, including human capital, natural resources, physical assets, financial capital, and social capital. The more assets a household controls, the more diverse the survival strategies they can adopt. Conversely, when livelihood assets are limited, survival strategies tend to be simpler and more basic (Putri et al., 2024).

From the SLF perspective, access to natural capital is not merely a matter of physical assets but also influences the capacity for reinvestment, the adoption of sustainable practices (e.g., *silvofishery*), and resilience to market fluctuations. These differences must also be interpreted through the GAD lens: gendered structures that restrict women's land rights have direct implications for their vulnerability and adaptive strategies.

Marginalization of Women in Accessing Resources

Nevertheless, the level of women's representation in Muara Mahakam's economic activities remains lower than that of men. Women's participation in decision-making and asset management remains limited (Choo, 2023; Rashid & Sultana, 2025). Women often lack authority over land and resource ownership (Begum et al., 2022; Rietveld et al., 2020). Women's land ownership rights are strongly associated with better outcomes for female-headed farming households (Montcho et al., 2023). In the context of patriarchal societies, women are often marginalized and lack adequate control over the proceeds of their labor, affecting their economic and social well-being. Women are frequently unrecognized in existing policies and management systems (Choo, 2023).

Limited access to education is a major factor hindering women's participation in economic activities. This study finds that many women in the Muara Mahakam Estuary have only attained basic education, impacting their ability to access information and training necessary for skill enhancement. The lack of formal education also contributes to women's low motivation to engage in activities outside the household (Chimerah, 2018). Elements such as land size, education, training, and improved awareness of women's land rights significantly contribute to higher income levels (Montcho et al., 2023; Tritsch & Le Tourneau, 2016). Women with lower levels of education require more accessible, locally based skills training interventions to enhance their human capital without relying solely on long-term formal education. These differences must also be interpreted through the Gender and Development (GAD) perspective, as gendered structures that restrict women's land rights have direct implications for their vulnerability and adaptive strategies. This condition reflects broader structural inequalities that limit women's access to productive resources in coastal communities.

Women's Involvement in Sustainable Ecosystem Management

Social and cultural norms that perceive women as less capable need to be transformed by encouraging their active participation in resource management (Akinola, 2018). Formally recognizing and acknowledging women's roles in fisheries management highlights their frequently overlooked contributions (Thomas et al., 2021), which in turn supports the sustainability of natural resources (Macusi et al., 2023). Their active participation, both individually and collectively, is crucial in driving and mobilizing collective action to protect resources in the Muara Mahakam region. This is in line with the findings of Rice et al., (2024), which show that gender-based power relations in natural resource governance limit women's substantive participation in decision-making, thereby deepening their cycle of marginalization.

The empirical patterns found in Muara Mahakam align with regional and international findings on gender-based livelihood strategies, climate adaptation, and community-based ecosystem management. In Southeast Asia, women generally occupy important roles in post-harvest processing, local marketing, and mangrove-based enterprises, yet their representation in formal decision-making and control over resources remains limited, as documented in FAO reports and regional syntheses on women's roles in small-scale fisheries and aquaculture (Kusakabe & Thongprasert, 2022).

In the Philippines, for instance, community-based mangrove management initiatives in Hinatuan Bay demonstrate that women's groups have been able to drive successful restoration, monitoring, and advocacy efforts, although they continue to face limitations in ownership and policy influence (Damastuti et al., 2022). This condition parallels the practical leadership of Mahakam women in *silvofishery* and the development of mangrove-derived products.

Study Limitations

This study, however, has several limitations. The analysis is based on a relatively small sample, meaning that the findings cannot yet be generalized to a broader population. Nevertheless, the stratified

approach employed, along with the integration of the Sustainable Livelihoods Framework dan Gender and Development theory, provides valuable insights into intra-group dynamics in women's livelihood strategies in Muara Mahakam.

The qualitative approach used with the informants uncovered implicit meanings that enriched the depth of this study's findings. For future research, these limitations could be addressed by expanding the sample size and diversity, covering more varied socio-economic backgrounds and geographical areas.

Conclusion and Suggestions

Conclusion

Women in Muara Mahakam play a dual role as household managers and key actors in the fisheries sector. They have access to various natural resources. However, unequal land distribution and patriarchal norms limit women's formal access to land, credit, and government assistance, thereby restricting their economic decision-making autonomy. At the same time, women support household economies and sustain the fisheries sector through the control of various forms of capital such as natural, human, fisheries-forestry, financial, physical, and social.

Their livelihood strategies include land intensification, such as cultivating vegetables in household yards and optimizing fishponds for consumption and sale. Extensification through *silvofishery* practices that integrate aquaculture with mangrove planting. Women also engage in water transportation services and essential goods trade. Support from social networks, government, and private sectors, through training and capital assistance, has strengthened women's economic capacity, particularly in fisheries and mangrove cultivation.

In sustainable ecosystem management, women utilize both abiotic and biotic components, managing pond areas, using sunlight for drying fish, and processing fishery by-products. They also contribute to coastal conservation by planting mangroves and utilizing marine and forest resources for food and value-added products, reinforcing their dual roles in ecological stewardship and local economic development.

Suggestion

These recommendations underscore the need for more targeted and practically implementable policies. One crucial step is integrating aquaculture training programs with gender-responsive microfinance schemes, so that women with lower levels of education and those without land ownership can still access technical skills as well as financial support to develop their enterprises. In addition, the provision of gender-responsive credit schemes, accompanied by the establishment of women-led cooperatives, can strengthen their bargaining position within fisheries value chains and broaden their access to markets. Land tenure policy reforms also need to be reinforced through mechanisms such as land certification under women's names, equitable inheritance, and land redistribution quotas for women, thereby minimizing gender gaps in access to natural capital. Furthermore, it is important to ensure women's formal representation in fisheries, forestry, and environmental governance, for example by setting membership quotas in fishers' associations, mangrove committees, and village conservation forums. At the same time, empowerment programs should support the diversification of sustainable resource-based enterprises, including the development of fishery processed products and mangrove-derived goods, so that women's economic sustainability progresses in tandem with coastal ecosystem conservation.

Acknowledgement

The authors gratefully acknowledge Universitas Negeri Yogyakarta for providing financial support for this research. The authors also thank the Forestry Extension Officers of KPHP Delta Mahakam and the local community in the Mahakam Estuary region for their valuable participation and support during the research process.

Author/Authors Brief Bio

Hastuti, Professor in Human Geography, Faculty of Social, Law, and Political Science, Universitas Negeri Yogyakarta.

Arum Sekar Kedhaton, Lecturer in Geography Education, Faculty of Teacher Training and Education, Universitas Mulawarman.

Nurul Khotimah, Lecturer in Geography Education, Faculty of Social, Law, and Political Science, Universitas Negeri Yogyakarta.

Nur Ariyanto, Lecturer in Geography Education, Faculty of Social, Law, and Political Science, Universitas Negeri Yogyakarta.

References

- Adzawla, W., & Baumüller, H. (2021). Effects of livelihood diversification on gendered climate vulnerability in Northern Ghana. *Environment, Development and Sustainability*, 23(1), 923–946. <https://doi.org/10.1007/s10668-020-00614-3>
- Agustianto, R., Purnamasari, I., & Suyitno, S. (2021). Analisis Data Ketinggian Permukaan Air Sungai Mahakam Daerah Kutai Kartanegara Tahun 2010-2016 Menggunakan Model Autoregressive Integrated Moving Average (ARIMA) Dengan Efek Outlier. *Ekspansional*, 11(1), 39–46.
- Akinola, A. O. (2018). Land reform in South Africa: An appraisal. *Africa Review*, 10(1), 1–16. <https://doi.org/10.1080/09744053.2017.1399560>
- Amalia, S., Effendi, A. S., Kesuma, A. I., & Wahyuni, E. (2023). Partisipasi Perempuan dalam Pemanfaatan Potensi Desa di Muara Badak Ulu Kutai Kartanegara. *Jurnal Pustaka Mitra (Pusat Akses Kajian Mengabdikan Masyarakat)*, 3(2), 101–105. <https://doi.org/10.55382/jurnalpustakamitra.v3i2.396>
- Anwar, Y., Setyasih, I., & Herlan, H. (2021). Partisipasi Masyarakat Terhadap Penanganan Permukiman Kumuh (Studi Kasus Di Kampung Ketupat Kecamatan Samarinda Seberang). *Journal of Education, Humaniora and Social Sciences (JEHSS)*, 4(1), 584–591. <https://doi.org/10.34007/jehss.v4i1.702>
- Anwar, Y., & Subagiyo, L. (2021). *Ekologi Pesisir: Kabupaten Kutai Kartanegara dan Kota Bontang Provinsi Kalimantan Timur*. Media Nusa Creative.
- Arthur-Holmes, F., Yeboah, T., & Abrefa Busia, K. (2023). Dimensions of women's mobility, livelihoods and vulnerability in artisanal and small-scale mining-induced local economy. *Journal of Rural Studies*, 101(July), 103061. <https://doi.org/10.1016/j.jrurstud.2023.103061>
- Azumah, F. D., Onzaberigu, N. J., & Adongo, A. A. (2023). Gender, agriculture and sustainable livelihood among rural farmers in northern Ghana. *Economic Change and Restructuring*, 56(5), 3257–3279. <https://doi.org/10.1007/s10644-022-09399-z>
- Baiduri, R., & Harahap, N. A. (2024). *Anthropos : Journal of Social and Cultural Anthropology Social Network of Muara Tanjung Women 's Group in Mangrove Forest Conservat.* 9(2), 129–139.
- Bataka, H. (2024). Global value chains participation and gender inequalities in Sub-Saharan Africa: Importance of women education. *International Economics*, 178(September 2023), 100483. <https://doi.org/10.1016/j.inteco.2024.100483>
- BBPSILH. (2017). *Pengembangan Tambak Ramah Lingkungan dengan Pola Kemitraan di Kawasan Hutan Mangrove Delta Mahakam*.
- Begum, F., Lobry de Bruyn, L., Kristiansen, P., & Islam, M. A. (2022). Forest co-management in the Sundarban mangrove forest: Impacts of women's participation on their livelihoods and sustainable forest resource conservation. *Environmental Development*, 43, 100731. <https://doi.org/10.1016/J.ENVDEV.2022.100731>
- BPS-Statistic of Kalimantan Timur Province. (2024). *Provinsi Kalimantan Timur Dalam Angka 2024*.
- Cameron, J., Vergara-Pinto, F., Carrasco Henríquez, N., Neves, C., de Cortillas, N., & Flores, C. (2024). Women gatherers of nalca (*Gunnera tinctoria*) as guardians of socioecosystems: Local history, extractivism and restoration in Chile. *Extractive Industries and Society*, 17(August 2023), 101394. <https://doi.org/10.1016/j.exis.2023.101394>
- Chapin, F. S., Torn, M. S., & Tateno, M. (1996). Principles of ecosystem sustainability. *American Naturalist*, 148(6), 1016–1037. <https://doi.org/10.1086/285969>
- Chimerah, R. M. (2018). *Assesment of Women's Participation in Livelihood Development Activities in Kwale Country, Kenya*. Pwani University.
- Choo, P. S. (2023). Women in sea cucumber fisheries and aquaculture—Can we make their participation equal and fair? In *The World of Sea Cucumbers: Challenges, Advances, and Innovations*. Elsevier Inc. <https://doi.org/10.1016/B978-0-323-95377-1.00036-9>
- Cook, N. J., Benedum, M. E., Gorti, G., & Thapa, S. (2023). Promoting women's leadership under environmental decentralization: The roles of domestic policy, foreign aid, and population change. *Environmental Science and Policy*, 139(November 2022), 240–249. <https://doi.org/10.1016/j.envsci.2022.11.007>
- Cookson, T. P., Kuss, M. K., Bitterly, J., & Fuentes, L. (2023). Social Norms, Gender and Development: A Review of Research and Practice. *UN Women Discussion Paper Series*, 42(42), 1–67.
- Damastuti, E., de Groot, R., Debrot, A. O., & Silvius, M. J. (2022). Effectiveness of community-based mangrove management for biodiversity conservation: A case study from Central Java, Indonesia. *Trees, Forests and People*, 7, 100202. <https://doi.org/https://doi.org/10.1016/j.tfp.2022.100202>

- Ekoula, M., William, H., Kamguia, B., & Ndoya, H. (2023). Do women hold the key to financial sector development in Africa? *International Economics*, 173(February 2022), 233–248. <https://doi.org/10.1016/j.inteco.2022.12.004>
- Founou, L. L., Yamba, K., Kouamou, V., Asare Yeboah, E. E., Saidy, B., Jawara, L. A., Bah, H., Sambe Ba, B., Aworh, M. K., & Darboe, S. (2023). African women in science and development, bridging the gender gap. *World Development Perspectives*, 31(November 2022), 100528. <https://doi.org/10.1016/j.wdp.2023.100528>
- Gebre, G. G., Isoda, H., Rahut, D. B., Amekawa, Y., & Nomura, H. (2021). Gender differences in agricultural productivity: evidence from maize farm households in southern Ethiopia. *GeoJournal*, 86(2), 843–864. <https://doi.org/10.1007/s10708-019-10098-y>
- Girma, H. (2021). *Evidence Brief. Do Land Rights Formalization Interventions Work for Women? December 2021*. <http://landwise-production.s3.amazonaws.com/2022/06/RE0022-Evidence-Brief-May-2022-v2.pdf>
- Hahury, H. D., & Soselisa, F. (2021). Strategi Penghidupan Rumah Tangga Pedesaan dalam Menghadapi Dampak Pandemi Covid-19. *Jurnal Pengabdian Pada Masyarakat*, 6(2), 343–350.
- Hardi, E. H., Susmiyati, H. R., Diana, R., Palupi, N. P., & Candra, K. P. (2023). Sosialisasi Budidaya Udang Dengan Model Smart Silvofishery Untuk Meningkatkan Kesejahteraan Masyarakat Di Kecamatan Muara Badak. *ABDIKU: Jurnal Pengabdian Masyarakat Universitas Mulawarman*, 1(2), 32–37. <https://doi.org/10.32522/abdiku.v1i2.380>
- Henderson, K., & Loreau, M. (2023). A model of Sustainable Development Goals: Challenges and opportunities in promoting human well-being and environmental sustainability. *Ecological Modelling*, 475, 110164. <https://doi.org/https://doi.org/10.1016/j.ecolmodel.2022.110164>
- Hendratmi, A., Agustina, T. S., Sukmaningrum, P. S., & Widayanti, M. A. (2022). Livelihood strategies of women entrepreneurs in Indonesia. *Heliyon*, 8(9), e10520. <https://doi.org/10.1016/j.heliyon.2022.e10520>
- Hutami, M. F. H., Ahmad, S., Ridwan, R., Fikri, M., Kurniawan, Y., Damayanti, E. K., & Ridwansyah, M. (2020). Peluang dan strategi pengurangan emisi di Kawasan Delta Mahakam, Kalimantan Timur. *E-Jurnal Ekonomi Sumberdaya Dan Lingkungan*, 9(3), 181–192. <https://doi.org/10.22437/jels.v9i3.12331>
- Jolpano, A., Handayani, I. E., & Saptiani, I. G. (2023). *The growth and accelerate molt of mud crab (Scylla serrata) given Boesenbergia pandurata extract in silvofishery ponds Salo Palai Village Muara Badak District Kutai Karanegara Regency*. 2(1), 1–10.
- Kedhaton, A. S., & Hastuti. (2023). *The Existence of Settlement and The Geography of Mahakam Estuary*. 25(2), 109–121. <https://doi.org/10.55981/jmb.2023.2066>
- Kusakabe, K., & Thongprasert, S. (2022). Women and men in small-scale fisheries and aquaculture in Asia. In *Women and men in small-scale fisheries and aquaculture in Asia*. FAO. <https://doi.org/10.4060/cb9527en>
- Li, J., Li, J., Nassani, A. A., Naseem, I., & Zaman, K. (2024). The impact of women's empowerment and access to finance on greenhouse gas emissions: A framework for securing environmental tranquility. *Borsa Istanbul Review*, 24(2), 341–351. <https://doi.org/10.1016/j.bir.2024.01.008>
- Macusi, E. D., Maynawang, I. S., Katikiro, R. E., Suyo, J. G., & Macusi, E. S. (2023). Women lead small-scale fisheries to sustainability in Surigao del Sur, Philippines. *Marine Policy*, 155(November 2022), 105768. <https://doi.org/10.1016/j.marpol.2023.105768>
- Montcho, M., Padonou, E. A., Montcho, M., Mutua, M. N., & Bayen, P. (2023). Impact of land tenure on livelihoods of women livestock-keepers in Burkina Faso. *Land Use Policy*, 133(August), 106848. <https://doi.org/10.1016/j.landusepol.2023.106848>
- Najam, R. (2024). Closing the gap: Effect of a gender quota on women's access to education in Afghanistan. *Economics of Education Review*, 99(November 2023), 102509. <https://doi.org/10.1016/j.econedurev.2024.102509>
- Nasrnia, F., & Ashktorab, N. (2021). Sustainable livelihood framework-based assessment of drought resilience patterns of rural households of Bakhtegan basin, Iran. *Ecological Indicators*, 128, 107817. <https://doi.org/https://doi.org/10.1016/j.ecolind.2021.107817>
- Nawari, F., & Purnamasari, E. (2023). Perubahan Iklim Dan Strategi Adaptasi Petambak Di Desa Salo Palai Kecamatan Muara Badak. *Jurnal Ilmu Perikanan Dan Kelautan*, 5(3), 352–363.
- Norhadi, N. (2019). Community Perception of Women Working in Palm Oil Plantations in the Village Saliki, Kecamatan Muara Badak, Kutai Kartanegara District. *SEPA: Jurnal Sosial Ekonomi Pertanian Dan Agribisnis*, 15(2), 147. <https://doi.org/10.20961/sepa.v15i2.25458>
- Okere, K. I., Dimnwobi, S. K., Ekesiobi, C., & Onuoha, F. C. (2024). Pollution, governance, and women's work: Examining African female labour force participation in the face of environmental pollution and governance quality puzzles. *Women's Studies International Forum*, 102(November 2023),

102851. <https://doi.org/10.1016/j.wsif.2023.102851>
- Pattimahu, T. V., Nikijuluw, J. B., Matdoan, A., Sangur, K., Siahaan, M., & Liur, L. M. (2023). Strategi Mata Pencarian Perempuan Pesisir Dalam Mempertahankan Keberlanjutan Ekonomi Rumah Tangga Di Daerah Kepulauan. *Equilibrium: Journal of Economics and Development Studies*, 1(1), 1–14. <https://doi.org/10.30598/equilibrium.1.1.1-14>
- Permaisari, R., Haqiqiansyah, G., & Erwianto. (2022). Kontribusi Istri Nelayan Dalam Meningkatkan Pendapatan Keluarga Inti di Desa Muara Wis Kecamatan Muara Wis Kabupaten Kutai Kartanegara. *Jurnal Multidisiplin Madani*, 2(8), 3483–3490. <https://doi.org/10.55927/mudima.v2i8.876>
- Putri, A. R., Genda, A., & Arifin, S. (2024). Strategi Penghidupan Perempuan Dalam Upaya Peningkatan Kesejahteraan Keluarga di Masyarakat Pesisir. *Journal of Humanity and Social Justice*, 77–93. <https://doi.org/10.38026/jhsj.v6i1.27>
- Rashid, H., & Sultana, Y. (2025). Women ' s Empowerment Activities in Rural Areas of Bangladesh. *American Journal of Youth and Women Empowerment*, 4(1), 1–8.
- Rice, E., Gondwe, E., Bennet, A., Okanga, P., Osho-Abdulgafar, N., Fakoya, K., Oloko, A., Harper, S., Kawaye, P., Chuku, E., & Smith, H. (2024). The Future of Gender Research in Small-Scale Fisheries: Priorities and Pathways for Advancing Gender Equity. *Fish and Fisheries*, 25(3), 401–408. <https://doi.org/10.1111/faf.12814>
- Rietveld, A. M., van der Burg, M., & Groot, J. C. J. (2020). Bridging youth and gender studies to analyse rural young women and men's livelihood pathways in Central Uganda. *Journal of Rural Studies*, 75(May 2019), 152–163. <https://doi.org/10.1016/j.jrurstud.2020.01.020>
- Rizal, S., & Jailani. (2022). Analysis of Plankton Abundance and Growth of Cultured Mud Clam in Mahakam Delta Pond. *Jurnal Ilmu Perikanan Tropis*, 1(2), 160–167.
- Saleh, S. E. (2014). Strategi Penghidupan Penduduk Sekitar Danau Limboto Provinsi Gorontalo. In *Tesis doctoral* (Issue Oktober).
- Scoones, I. (1998). Sustainable Rural Livelihood: A Framework for Analysis. In *The Institute of Development Studies and Partner Organisations*. <https://doi.org/10.18502/jnfs.v6i2.6060>
- Setiawan, Y., Bengen, D. G., Kusmana, C., & Pertiwi, S. (2015). Estimasi Nilai Eksternalitas Konversi Hutan Mangrove Menjadi Pertambakan. *Journal Hutan Tanaman*, 12(3), 201–210.
- Simarmata, K., Widhagdha, M. F., Pradipta, G., Aditya, R., & Saipullah. (2023). Realizing Gender Equality in Coastal Areas: Conservation of Critical Land and Empowerment of Women. *Asean Social Work Journal*, 11(1), 63–73. <https://doi.org/10.58671/aswj.v11i1.40>
- Sodikin, Nurkholifah, & Said, M. (2021). *Spatial Modeling of Mangrove Deforestation in Mahakam River Delta Kutai District Kartanegara Province of East Kalimantan*. 1(3), 180–186.
- Syah, R., Ginting, P., & Eryati, R. (2024). *Study Of Stock Status And Exploitation Rate Of Mangrove Crabs In Muara Kembang Village Muara Jawa District , East Kalimantan*. 3(1), 16–26. <https://doi.org/10.30872/tas.v3i1.1220>
- Thomas, A., Mangubhai, S., Fox, M., Meo, S., Miller, K., Naisilisili, W., Veitayaki, J., & Waqairatu, S. (2021). Why they must be counted: Significant contributions of Fijian women fishers to food security and livelihoods. *Ocean and Coastal Management*, 205, 105571. <https://doi.org/10.1016/j.ocecoaman.2021.105571>
- Tritsch, I., & Le Tourneau, F. M. (2016). Population densities and deforestation in the Brazilian Amazon: New insights on the current human settlement patterns. *Applied Geography*, 76, 163–172. <https://doi.org/10.1016/J.APGEOG.2016.09.022>
- Wahyuni, T., Wahyudi, A., Rojikin, A., Effendi, H., Yuliana, H., Sakuntaladewi, N., & Akhmad, C. (2020). *Safeguards Sosial Dan Lingkungan*.
- Zuraida, I., Yuli, A., & Kusumaningrum, I. (2020). Pemanfaatan Buah Mangrove Sonneratia Sp. Sebagai Bahan Baku Sirup Di Desa Tani Baru Kabupaten Kutai Kartanegara. *Jurnal Masyarakat Mandiri*, 4(5), 3–10.

